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PERSONAL HEAT CONTROL DEVICE AND METHOD

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PERSONAL HEAT CONTROL DEVICE AND METHOD

[0001] This application claims the benefit of U.S. Provisional Application No. 60/396,829, filed July 17, 2002, which is incorporated herein by reference.

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BACKGROUND

Field

[0003] Embodiments of the present invention relate generally to personal heat control. More particularly, embodiments of the present invention relate to self-contained personal heat control devices that may be stand-alone, dedicated devices, integrated into or temporarily affixed or attached to other conventional devices, integrated into or temporarily affixed or attached to articles of clothing, or otherwise conveniently worn on a person to achieve cooling or heating of the person's body.

Description of Related Art

[0004] In a hot or cold environment, it is often desirable to have access to convenient, personalized heat control to improve personal comfort in such an environment. For example, placing a cool item against the skin of a person who is staying in a hot environment tends to alleviate the person's discomfort due to the high temperature. This invention provides a device and method for supplying a source for personalized heat control.

SUMMARY

[0005] Methods and apparatus for personal heat control are described. According to one embodiment of the present invention, a self-contained, portable heat control device includes a flexible enclosure, a cooling surface, a heating surface, and a heat transfer unit. The flexible enclosure is configured to accommodate an internal DC power supply. The heating surface is thermally insulated from the cooling surface. The heat transfer unit is accommodated in or on the flexible enclosure and is configured and disposed to cool the cooling surface and heat the heating surface.

[0006] Other features of embodiments of the present invention will be apparent from the accompanying drawings and from the detailed description that follows.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0007] Embodiments of the present invention are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which like reference numerals refer to similar elements and in which:

[0008] **Figure 1** depicts an illustrative cross-sectional side view of a personal heat-control device constructed as a flexible strip according to one embodiment of the present invention.

[0009] **Figures 2A and 2B** depict front and back views of a personal heat-control device integrated within an ornamental key FOB, pendant or medallion according to one embodiment of the present invention.

[0010] **Figure 3** depicts a personal heat-control devices integrated within an ornamental key FOB, pendant or medallion according to an alternative embodiment of the present invention.

[0011] **Figure 4** depicts a personal heat-control device integrated within an ornamental key FOB, pendant or medallion according to yet another embodiment of the present invention.

[0012] **Figures 5A-C** depict front, back, and side views, respectively, of a wrist watch having an integrated or removably attached personal heat-control device according to one embodiment of the present invention.

[0013] **Figures 6A and 6B** depict front and back views, respectively, of a mobile phone having an integrated or removably attached personal heat-control device according to one embodiment of the present invention.

[0014] **Figures 7A and 7B** depict a flexible personal heat-control device which may be incorporated within or removably attached to a baseball cap according to one embodiment of the present invention.

[0015] **Figure 8** depicts a head band, wrist band, or the like having a personal heat-control device according to one embodiment of the present invention.

DETAILED DESCRIPTION

[0016] Methods and apparatus for personal heat control are described. Broadly stated, a self-contained personal heat control device includes a heat transfer unit, such as a thermoelectric cooling module employing a phenomenon known as the "Peltier Effect," for providing cooling and heating. According to one embodiment, a Peltier-effect unit is mounted in or on a flexible enclosure that is either wearable by a person or removably attachable to a wearable item such as an article of clothing, athletic gear, safety or protective gear, or accessories.

[0017] According to another embodiment, a personal heat-control device may be a stand-alone device or integrated within an accessory or other conventional portable device, such as a key FOB, pendant, cellular phone, pager, personal digital assistant. The portable device whether integrated or stand-alone enables heat transfer to be made from or to a person's body for comfort or refreshment purposes by directly or indirectly engaging a heating surface or a cooling surface of the device with, for example, the palm of ones hand, the inside of the wrist, the forehead, the temple, or other area of the body where blood vessels are close to the skin surface. Advantageously, in this manner, rapid and effective transfer of heat for cooling or warming the body can be achieved. Additionally, according to various embodiments of the present invention, the cooling or warming can be achieved with economical expenditure of electrical energy and under close control. Miniature personal cooling devices (PCDs) bring a new dimension to personal cooling in the fields of leisure, fashion, healthcare and sport; and eliminate or reduce the need for fans, ice crystals, water sprays and bulky collar coolers.

[0018] A more general description of personal heat control device using a Peltier-effect unit has been given in the U.S. Patent Number 5,970,718, entitled "PERSONAL HEAT CONTROL" and issued to the present inventor. U.S. Patent Number 5,970,718 is hereby incorporated herein by reference.

Terminology

[0019] Brief definitions of terms used throughout this application are given below.

[0020] The terms "connected" or "coupled" and related terms are used in an operational sense and are not necessarily limited to a direct connection or coupling.

[0021] The term "flexible" generally means bendable and adaptable under relatively little force. In the context of various embodiments of the present invention, flexible is intended to describe the dynamic conforming nature of the personal cooling device to the general shape of a portion of a person's body, such as wrist, ankle, neck, shoulder, back, chest, forehead, rib cage, arch, temple, palm, etc., directly or indirectly in contact with or otherwise engaging a surface of the PCD. In this regard, flexible relates to the lack of memory of the material so described or the disinclination of the material to maintain a particular shape other than its original shape. Rather, according to various embodiments described herein, a flexible PCD band or strip has sufficient adaptability to be incorporated and/or removably attached to athletic apparel or gear, clothing, accessories, headwear, safety or protective gear, including, but not limited to biking shorts, biking jerseys, exercise suits, sport bras, spandex pants, shorts, tops, shirts, gloves, shoes, boots, socks, heart monitors, wrist watches, wrist bands, glasses, sunglasses, headphones, medallions, pendants, jewelry (e.g., necklaces, bracelets, anklets), uniforms, baseball caps, golf caps, visors, head bands, hats, chemical suits, bio suits, space suits, bullet-proof vests, fire protective suits, motorcycle leathers, goggles, hard hats, motor racing helmets, motor cycle helmets, bicycle helmets, football helmets, batting helmets, and the like, so as to move with, adapt and conform to the portion of the body as it bends, moves, flexes, twists, etc.

[0022] The phrases "in one embodiment," "according to one embodiment," and the like generally mean the particular feature, structure, or characteristic following the phrase is included in at least one embodiment of the present invention, and may be

included in more than one embodiment of the present invention. Importantly, such phases do not necessarily refer to the same embodiment.

[0023] If the specification states a component or feature "may", "can", "could", or "might" be included or have a characteristic, that particular component or feature is not required to be included or have the characteristic.

[0024] **Figure 1** shows an illustrative cross-sectional view of a personal heat-control device 100 constructed as a flexible strip according to one embodiment of the present invention. In this example, a heat transfer unit 101, such as a thermoelectric-cooling unit employing the Peltier Effect (a Peltier-effect unit), is formed of a stainless steel strip core 102 or similar conductive alloy, metal, or material, such as aluminum or copper, that functions as a spreader to enlarge the cooling surface of one or more ceramic thermoelectric Peltier modules 104. The dimensions of the stainless steel strip core 102 may be tailored for the particular application. Empirical data suggests that strips of approximately 0.25mm thickness, 12mm width, and 100mm length is sufficient in terms of flexibility and cooling ability for the baseball cap embodiment, for example, discussed below. According to one embodiment, the spreader (e.g., the stainless steel strip core 102) may be excluded altogether and the cold ceramic faces of the one or more ceramic thermoelectric Peltier modules 104 may form a cooling surface of the personal heat-control device 100.

[0025] The stainless steel strip core 102, which may be pre-coated by powder coating, in this example, represents the cold face or cooling surface to be exposed on the cold side of the Peltier-effect unit. The back (inside) surface of the stainless steel core 102 has mounted thereon the cold ceramic face of one or more thermoelectric Peltier modules 104 fixed with a thermally conductive adhesive, such as double sided tape, epoxy cement or the like.

[0026] On the hot ceramic face of each Peltier module will be mounted an

aluminum (or similar conductive alloy, metal, or material, such as magnesium) heat sink block or strip 103, which may be partially or fully exposed on a hot face of the PCD or ventilated sufficiently via the use of a breathable material enclosure or one or more open channels or troughs in enclosure materials to enable more efficient dissipation of heat. Individual heat sink blocks 103 may be on the order of .5mm thick, 10mm wide and 15mm long. Strip metal heat sinks may be thinner, however, the length should be selected so as to maintain the flexibility of the PCD for the intended application. As above, a thermally conductive adhesive, such as double sided tape, epoxy cement or the like, may be used to mount the heat sinks onto the Peltier modules 104. According to one embodiment, the surface area of the heat sink 103 may be several times the size of the cooling surface 102, e.g., two to seven times larger depending upon the materials used, to promote rapid heat dissipation.

[0027] As is well-known, Peltier modules (also referred to as thermoelectric modules (TEMs) or thermoelectric coolers (TECs)) are highly efficient heat pumps that directly convert electricity into heating and cooling power. When power is supplied to the Peltier modules, the current causes one side of the Peltier modules and hence one side of the PCD (the cool side) to absorb heat. Meanwhile, the other side of the Peltier modules (the hot side) release heat (the hot side). That is, the Peltier module causes heat to flow from the cool side to the hot side. Reversing the current causes the heat to be moved in the opposite direction thereby reversing the hot side and the cold side. Consequently, according to one embodiment, the heating or cooling effect produced by a particular surface of the PCD may be selectable by the end user.

[0028] In the embodiment depicted, the basic PCD elements described above are encapsulated within an optional soft-faced and flexible housing/enclosure 110 constructed of one or more bonded layers of one or more of polyester (polyether), polyethylene, polypropylene, nylon, kevlar, nomex, polyacrylonitrile, cellulose, and polyurethane, or similar foams and/or fibers. Use of flexible, soft-faced materials that are

also breathable will facilitate the dispersing of heat generated by the Peltier modules 104 through the housing or enclosure.

[0029] Within this flexible housing are formed chambers of sufficient size and shape to house one or more DC power supplies 115 to power optional electronics and provide current to the heat transfer unit 101. Also, optionally housed are one or more of a timer, a solid-state electronic timing switch 109, an IC chip, and a electro-luminescence (EL) device.

[0030] According to one embodiment, the PCD 100 is as convenient to recharge as a mobile phone. The DC power supplies 115 may be Lithium Ion (Li-ion) rechargeable batteries with solid state electrolyte or lithium thin cell primary batteries electrically connected, e.g. by wires or conductive strips, to energize the heat transfer unit 101 on activation of the optional solid state electronic timing switch 109 mounted on the outside of the flexible enclosure. According to one embodiment of the present invention, the batteries used to power the circuitry in the PCD may be Nickel Cadmium (Ni-Cd), Nickel Metal Hydride (Ni-MH) or other type of rechargeable batteries. They can also be disposable batteries. The batteries themselves can be constructed in flexible form, such as those developed by Power Paper Ltd., based in Tel Aviv, Israel. For example, a flexible battery may be printed directly onto paper, plastic or other flexible material.

[0031] According to another embodiment, the DC power supplies 115 comprise fuel cells, such as those utilizing methanol cartridges, for example, or solar cells. The DC power supplies 115 may be embedded in a sealed flexible enclosure with the rest of the PCD circuitry, enclosed in an openable enclosure (particularly suited for disposable batteries or fuel cell cartridges), or external to the PCD enclosure. Recharging batteries within the flexible PCD can be achieved via either a 2- or 3-pin flat connector or alternatively a circular connector, for example, any of which can be recessed into the flexible housing 110, on any face of the unit 100.

[0032] On the cold face 125 of the PCD 100, the soft-faced, flexible housing 110

is cut or otherwise molded or formed to expose, preferably in a flush manner, the cold face of the stainless steel core 102. On the hot face 120 of the PCD 100, the soft housing 110 can optionally be cut or otherwise molded or formed to expose the heat sink(s) 103. The outer surface of the hot side 120 may have a Velcro attachment material or similar material, mounted and adhered to it. This material may cover the entire surface of the soft and flexible housing 110 on the hot side 120 of the PCD 100 with the exception of the heat sinks 103, which can be exposed to assist the dissipation of heat.

[0033] It has been found that a pleasant cooling effect is achieved when the unit is activated and the cooling surface 102 is applied to a portion of the body where blood vessels are close to the surface of the skin for between about 15 seconds to one minute. The timing switch circuitry 109, may prevent or otherwise limit successive reactivation of the unit 100 for a short period, to allow heat generated in the unit 100 to disperse through the hot face 120 of the housing 110, which may be formed of a thermally conductive material to support more rapid heat dissipation and increase the effective surface area of the heat sink.

[0034] **Figures 2A and 2B** depict front and back views of a personal heat-control device integrated within an ornamental key FOB, pendant or medallion according to one embodiment of the present invention. In the example depicted, a medallion 200 includes an activation switch 205 on the front face. The encasing 207 is formed of aluminum or other metal, alloy, or other heat conductive material and acts as a heat sink. On the backside, one or more cool spots 210 are provided. While in this example, the cool spot 210 is comprised of the cold ceramic faces of one or more ceramic TECs, in alternative embodiments, an optional spreader may increase the surface area of the cool spot 210.

[0035] **Figures 3 and 4** depict alternative embodiments of a personal heat-control devices integrated within ornamental key FOBs, pendants or medallions.

[0036] **Figures 5A-C** depict front, back, and side views, respectively, of a wrist watch having an integrated or removably attached personal heat-control device according to one embodiment of the present invention. In an embodiment in which the PCD is integrated with the watch, the PCD and watch may share the same DC power source.

[0037] **Figures 6A and 6B** depict front and back views, respectively, of a mobile phone 600 having an integrated or removably attached personal heat-control device according to one embodiment of the present invention. In the example illustrated, one or more cool spots 605 are provided on the backside of the mobile phone 600. Alternatively, cool spots could be positioned on the front side of the mobile phone 600 or they could be present on more than one surface. As above, the surface area of the one or more cool spots 605 may be increased according to alternative embodiments by employing an optional spreader, such as a thin conductive foil. In an embodiment in which the PCD is integrated with the mobile phone 600, the PCD and mobile phone 600 may share the same DC power source.

[0038] **Figures 7A and 7B** depict a flexible personal heat-control device which may be incorporated within or removably attached to a baseball cap 700 according to one embodiment of the present invention. In the embodiment depicted, a flexible PCD 710 is removably affixed to the baseball cap 700 using a fastener such as a fabric hook-and-loop fastener, such as Velcro strips 705 and 706 or a similar form of attachment. In one embodiment, the device is sufficiently flexible to conform easily to the general shape of the baseball cap 700 and the wearer's forehead.

[0039] In the embodiment depicted, the surface of the PCD 710 that will be in contact with the wearer's forehead includes one or more cool spots 712 and the opposite side includes the attachment means for attaching to the baseball cap 700 and an exposed

heat sink 711.

[0040] While in the embodiment depicted, the flexible PCD is illustrated as being removably attachable to the baseball cap 700 and therefore repositionable, one or more flexible PCDs may also be more permanently incorporated within a wearable article in alternative embodiments. For example, in the case of a baseball cap, the flexible PCD may be inserted through a slit in the liner, placed into a preformed pocket in the liner, or even sewn into the liner.

[0041] **Figure 8** depicts a band 800 having a personal heat-control device according to one embodiment of the present invention. In this example, the band 800 includes a PCD 810, such as that depicted in **Figure 1** (with or without the flexible housing 110), and a strap 815, such as an elastic loop. The PCD 810 may be fitted into elastic or stretchable material or toweling for comfort and the cold surface may rest directly or indirectly against the wearer's skin. The band 800 may be worn as a head band, wrist band, or the like depending upon the size and configuration of the PCD 800 and the strap 815.

[0042] While exemplary usage models for personal cooling and embodiments of PCDs have been illustrated and described herein, they are not intended to be exhaustive. Alternative embodiments of the present invention are thought to have broad applicability in the fields of leisure, fashion, healthcare and sport. For example, one or more portable and flexible PCDs may be incorporated within and/or removably attached to athletic apparel or gear, clothing, accessories, headwear, safety or protective gear, including, but not limited to biking shorts, biking jerseys, exercise suits, sport bras, spandex pants, shorts, tops, shirts, gloves, shoes, boots, socks, heart monitors, wrist watches, wrist bands, glasses, sunglasses, headphones, medallions, pendants, jewelry (e.g., necklaces, bracelets, anklets), uniforms, baseball caps, golf caps, protective clothing (e.g., surgeon

caps, gardening hat, sun hat), police or military caps/hats or headgear, visors, head bands, hats, chemical suits, bio suits, space suits, bullet-proof vests, fire protective suits, motorcycle leathers, goggles, hard hats, motor racing helmets, motor cycle helmets, bicycle helmets, football helmets, batting helmets, and the like.

[0043] According to other embodiments of the present invention, a PCD may be part of a stand-alone dedicated portable cooling device or integrated into or temporarily affixed or attached to other conventional consumer devices, including, but not limited to cameras, key chains, pulse monitors, etc. Optionally, the PCD may include timers or EL devices. Their operation can be modulated by one or more IC chips. For example, the PCD could employ a timing device modulated by an IC chip to periodically activate cooling for a predetermined (e.g., 10, 15, 30 seconds) or user-adjustable amount of time. Additionally, the timing device may control the minimum time between operations in order to allow batteries to recover and/or allow appropriate heat dissipation.

[0044] EL technology (electro-luminescence) can be incorporated into a PCD according to one embodiment of the present invention. For example, a strobe light of white, red or blue color can be used to accompany the operation of a PCD to indicate, among other things, the "on" state of the PCD and cooling or heating operation of the PCD. Pulsating strobe lights can be modulated by an IC chip. The voltage needed for strobe lights can be produced by, for example, high frequency power converters.

[0045] The particular embodiments disclosed above are illustrative only, as the invention can be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the invention. Accordingly, the protection sought herein is as set

forth in the claims below.